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## BACKGROUND OF THE INVENTION

10 The invention relates to the making of rod-shaped products which contain flowable particulate material, such as fragments of tobacco leaves, artificial tobacco and/or reconstituted tobacco. More particularly, the invention relates to improvements in apparatus for advancing and simultaneously influencing (such as reshaping, condensing, changing the speed of and/or changing the direction of advancement of) streams or flows of particles of smokable material.

15 A modern cigarette making machine (e.g., the machine known as PROTOS which is distributed by the assignee of the present application) comprises a conveyor which gathers particles of tobacco leaves and/or other combustive tobacco smoke producing material (such particles will be referred to as tobacco particles) into at least one rod-like filler ready to be trimmed and thereupon draped into a running web of cigarette paper or other suitable wrapping material. To this end, the  
20 conveyor includes a duct defining an elongated path arranged to receive a continuous shower of tobacco particles. The shower is converted into an elongated stream by an elongated stretch or reach of an endless foraminous belt. One side of such reach is adjacent a  
25 suction chamber and the particles are attracted to the

other side of the reach to advance along the aforementioned path toward a trimming or equalizing station where the surplus of smokable material is removed by a system of knives so that the stream is converted into a rod-like filler ready to be draped into the web of cigarette paper or the like. Reference may be had, for example, to commonly owned US patent No. 5,072,742 granted December 17, 1991 to Heitmann for "METHOD OF AND APPARATUS FOR MAKING A FILLER OF SMOKABLE MATERIAL".

As a rule, or at least in many instances, the shower of tobacco particles is caused to rise into the duct to form a stream at the underside of the lower reach of the foraminous belt. Thus, the lower reach of such belt constitutes one wall of the duct, and the duct includes stationary additional walls serving to flank the sides of the path beneath the lower reach of the belt and being in continuous contact with the moving tobacco particles.

A modified conveyor for advancement and conversion of a shower of tobacco particles into a tobacco stream is disclosed in commonly owned published German patent application Serial No. 197 33 443 A1.

A drawback which is common to presently known conveyors of the above outlined character is that the stationary walls which come in contact with tobacco par-

articles are subject to extensive wear due to continuous pronounced uninterrupted frictional engagement with the advancing stream of comminuted tobacco. This affects the useful life of the conveyor. Moreover, such pronounced frictional engagement can exert adverse influence upon the consistency and/or configuration of the growing tobacco stream in the duct.

Attempts to ensure that the stationary walls of the duct of the conveyor will offer relatively low resistance to sliding movement of tobacco particles therealong include the coating of such walls with linings of tungsten carbide. This material exhibits a satisfactory resistance to wear; however, its coefficient of friction is very high so that it can affect the quality of cigarettes, e.g., in that the weights of numerous cigarettes depart considerably from an optimum or acceptable weight, and the quality of the tobacco-containing ends of the ultimate products is less than satisfactory.

The aforementioned published German patent application Serial No. 197 33 443 A1 proposes to provide the duct which receives the shower of tobacco particles with ceramic tracks serving to guide the continuously moving endless belt and holding it in an optimum position relative to those stationary walls of the duct which are in continuous contact with the sides of the growing and

advancing tobacco stream. The published German patent application does not disclose or suggest the making of such stationary walls of a ceramic material, i.e., to employ a ceramic substance as the material of stationary walls which are in continuous and extensive contact with comminuted smokable material.

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## OBJECTS OF THE INVENTION

5 An object of the present invention is to provide a conveyor which is constructed and assembled in such a way that all stationary parts which come into extensive contact with moving tobacco particles exhibit several desirable properties, especially a pronounced resistance to wear and a low resistance to sliding of tobacco particles therealong.

10 Another object of the instant invention is to provide a conveyor wherein the stationary walls which come in direct contact with the conveyed tobacco particles and/or with the moving belt are subject to less pronounced wear than in conventional conveyors.

15 A further object of the invention is to increase the area of contact between the moving belt and the tracks which guide the belt for movement along a desired path in a cigarette rod making machine.

20 An additional object of the present invention is to provide a novel and improved method of prolonging the useful life of the belt and/or of other parts in a conveyor of the above outlined character.

25 Still another object of this invention is to provide a cigarette making machine which employs one or more conveyors exhibiting the above-enumerated desirable characteristics.

A further object of our invention is to provide a conveyor which can be utilized with advantage in modern high-speed cigarette rod making machines which are designed to turn out huge quantities of cigarettes or analogous rod-shaped smokers' products per unit of time.

Another object of the invention is to provide a conveyor which can be utilized in machines designed to turn out a single continuous cigarette rod as well as in machines which can turn out simultaneously a plurality of continuous cigarette rods.



## SUMMARY OF THE INVENTION

10 15 20 25

The invention resides in the provision of a conveyor for flowable particulate material of the tobacco processing industry wherein a duct defines a path for the flowable material and has walls bounding the path, i.e., being in direct contact with moving particulate material. In accordance with a feature of the invention, at least one of the walls consists at least in part of a ceramic material, i.e., such ceramic material comes in direct contact with the moving particulate material.

The at least one wall is or can be stationary, and such at least one wall can constitute a lining having a surface adjacent the path and consisting of ceramic material. The duct of such conveyor can comprise a back support for the lining; the lining is affixed to the back support in such a way that it is disposed between the back support and the path for moving particulate material. For example, the lining can be bonded (such as by a suitable adhesive) to its back support and the thickness of such lining can be between about 0.05 mm and 0.5 mm. Instead of being bonded to the back support, the lining can be applied to the back support in molten state, and such molten material can be poured or sprayed onto the back support.

That surface of the at least one wall of the duct

which is adjacent the path for and is contacted by the moving particulate material can have a consistency or configuration resembling that of an orange peel or rind.

Another wall of the duct can constitute a portion (e.g., an elongated lower reach or stretch) of a conveyor belt which is arranged to advance particulate material along the path. A third wall of such duct can be installed to confront the at least one wall and is preferably disposed at that side of the belt portion which faces the at least one wall. The third wall consists, or can consist, at least in part of a ceramic material, e.g., of a material identical with that of the at least one wall. Two additional walls of such duct can be disposed at the other side of the aforementioned portion of the belt and are or can be designed to provide (i.e., establish or constitute) tracks or guideways for the aforementioned portion of the belt. At least one of the additional walls can be provided with one or more projections (e.g., with substantially trapeziform arms or the like) which abut the other side of the elongated portion of the belt. The additional walls can be provided with surfaces each of which is adjacent and extends lengthwise of a different one of the two elongated marginal portions (edge faces) of the elongated portion of the belt. The latter is or can be located at

a level above the path, i.e., at a level above the at least one wall and the third wall of the duct. The duct can form part of a cigarette rod making machine.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved conveyor itself, however, both as to its construction and the modes of assembling and utilizing the same, together with numerous additional important and advantageous features and attributes thereof, will be best understood upon perusal of the following detailed description of certain presently preferred specific embodiments with reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a transverse sectional view of a conveyor which embodies one form of the present invention and employs a total of four walls made at least in part of a wear-resistant ceramic or ceramic-containing material;

Fig. 2 is an enlarged view of a detail in the structure of Fig. 1; and

Fig. 3 is a plan view of certain parts in a modified conveyor.

## DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 shows a portion of a conveyor 2 which embodies one form of the present invention and includes an elongated channel or duct defining an elongated path 1 for reception and advancement of successive increments of a continuous ascending shower of tobacco particles forming a stream at the underside of the lower reach or stretch 20 of an endless foraminous belt being driven in a manner not shown in the drawings to advance tobacco particles in a direction at right angles to the plane of Fig. 1. Reference may be had, for example, to Fig. 3 of the aforementioned US patent No. 5,072,742 to Heitmann which shows a conventional conveyor having an endless foraminous belt 61 including a lower reach located below the perforated bottom wall 59 of a suction chamber 61 and above the open upper end of a tubular guide 52 for an ascending shower of tobacco particles. The ascending shower of tobacco particles gathers into a continuous stream which is advanced along an at last substantially horizontal path and past a surplus removing or equalizing device. The resulting rod-like filler 78c is draped (at 89) into a web 91 of cigarette paper to form therewith a continuous cigarette rod ready for repeated severing of its leader to yield a succession of discrete plain cigarettes of unit length or multiple unit length. The structure shown

in Figs. 1 and 2 of the present application is a cross-sectional view of the novel conveyor 2 taken at right angles to the plane in Fig. 3 of the patent to Heitmann.

Referring again to Figs. 1 and 2 of the present application, the lower reach 20 of the endless belt is located at a level below two confronting sidewalls or cheeks 8, 10 mounted in a housing 4. The sidewalls 8, 10 are connected to each other and form part of a holder 6 which is bolted, screwed or otherwise affixed to the two halves of the housing 4. These sidewalls are respectively provided with elongated grooves 12, 14 for discrete inserts or walls 16, 18 respectively adjacent the lateral marginal portions or edge faces 30, 32 of the lower reach 20 of the belt. The inserts 16, 18 are respectively provided with guide surfaces 22, 24 for the respective edge faces 30, 32. The configurations of the surfaces 22, 24 bounding the grooves or cutouts 12, 14 are such that the lower reach 20 of the endless belt is compelled to advance in an accurately defined plane extending at least substantially at right angles to the plane of Fig. 1 or 2.

The suction chamber 48 in the interior of the housing 4 above the lower reach 20 of the endless belt attracts the fragments of tobacco particles in a manner to form a stream which is entrained by the lower reach

8. The upper side of this lower reach is propped by the surfaces 25 of several rollers 28 rotatably mounted in the suction chamber 48 on horizontal shafts 26. The shafts 26 are installed in the cheeks 8 and 10.

5 The inserts or walls 16, 18 are further provided with parallel surfaces 34, 36 which are adjacent the edge faces 30, 32 of the lower reach 20.

10 The duct of the conveyor 2 further includes parallel walls 44, 46 which flank the channel or path 1 and are respectively borne by back supports 38, 40 secured to and depending from the respective portions of the housing 4. Each of the walls 44, 46 is bonded (such as glued) to the respective back support 38, 40. Those surfaces of the back supports 38, 40 which are adjacent the walls 44, 46 are provided with pairs of shallow recesses 42 which can receive the adhesive. This adhesive can be of the type known as Delo Automix 1895 distributed by the Firm Delo in Landsberg am Lech, Federal Republic Germany. Each of the walls or linings 44, 20 46 can consist of a series of successive panels or plates which are placed next to each other to jointly form composite linings extending beneath the lower reach 20 of the endless belt in a direction at right angles to the plane of Fig. 1 or 2.

25 It will be seen that the path 1 is bounded by a total

of three walls which actually contact, guide and entrain the tobacco particles rising into the duct, namely by the lower reach 20 of the endless belt, by the wall constituted by the composite lining 44, and by the wall including the composite lining 46. In accordance with a feature of the present invention, at least the wall 44 but preferably also the wall 46, and most preferably also the walls or inserts 16, 18 is or are made of a ceramic material.

The friction coefficient of the ceramic material of the linings 44 and 46 is low or very low, i.e., the exposed surfaces of these linings offer only a relatively small or negligible resistance to sliding movement of tobacco particles therealong. This ensures that the quality of cigarettes which have rod-like fillers built up in a machine embodying the structure shown in Figs. 1 and 2 is not unduly affected by the walls 44, 46 because these walls do not unduly interfere with the distribution (in the duct 1) of tobacco particles in a manner as determined by the means for propelling tobacco particles into the duct from below, by suction in the chamber 48 and/or by the speed of forward movement of the lower reach 20 of the belt.

The making of the inserts or walls 16, 18 of a ceramic material (such as  $Al_2O_3$ ) is desirable and advan-



5 tageous but optional. On the other hand, the making of  
the walls 44, 46 from a ceramic material (at least in  
part) is highly desirable and constitutes an unexpectedly  
advantageous feature of the present invention. The  
ceramic material of portions of or of the entire walls  
44, 46 is or can be the same as that of the portions of  
or of entire inserts or walls 16 and 18. The utilization  
of a ceramic material for the walls 44, 46 has been found  
to contribute significantly to the useful life of the  
conveyor 2 and is attributable to the unexpected  
discovery that the coefficient of friction between cera-  
mic walls and a shower and/or stream and/or other flow  
of tobacco particles is surprisingly low so that, once  
installed, such panels or walls 44, 46 as well as the  
walls or inserts 16, 18 can stand long periods of  
continuous use in a tobacco processing machine. This  
holds true regardless of whether the belt including the  
reach or stretch 20 is driven slowly (e.g., during start-  
ing) or while the vehicle embodying the structure shown in  
Figs. 1 and 2 is driven at a relatively high speed.

The neighboring panels of a composite ceramic  
lining (such as 44 or 46) can be properly (such as form-  
locking) interfitted with each other by mechanical  
means, e.g., by providing neighboring edge faces of such  
panels with mating teeth or with otherwise configured

overlapping parts (such as ledges or the like).

In lieu of employing prefabricated ceramic or partly ceramic walls, it is also possible to employ a flowable ceramic material which is poured or sprayed onto selected surfaces of the back supports 38 and 40. The same holds true for the inserts or walls 16 and 18. The substances which are to be sprayed onto the confronting surfaces of the cheeks 38, 40 can be made of a ceramic material or they can contain a certain percentage of or inlays made from a suitable ceramic material.

An additional important advantage of ceramic or partly ceramic linings 44, 46 is that such linings can be applied to the back supports in presently known or utilized panels of metal or the like. Thus, all that is necessary to significantly improve a conventional conveyor is to replace standard linings with novel linings of the type shown, e.g., in Figs. 1 and 2. Such undertaking can significantly lengthen the useful lives of existing standard conveyors.

The utilization of walls or linings 44, 46 having tobacco-contacting surfaces of a configuration similar to that of an orange rind has been found to contribute to longer useful life of the conveyors which embody the present invention.

The spacing between the surfaces 34, 36 of the

inserts or walls 16, 18 is such that the surfaces 34, 36 need not come into contact with the lower reach 20 of the endless belt; this greatly reduces the likelihood of excessive wear upon the edge faces of the foraminous belt including the lower reach 20.

A cigarette making machine which can employ a conveyor with two paths (or two discrete conveyors each defining a path 1) is disclosed, for example, in commonly owned US patent No. 4,893,640 granted January 16, 1990 to Heitmann et al. for "MULTIPLE-ROD CIGARETTE MAKING MACHINE".

Fig. 2 shows, drawn to a larger scale, those portions of the conveyor 2 which surround the lower reach 20 of the endless belt that surrounds the suction chamber 48.

Fig. 3 is a plan view of a portion of a conveyor 2a which constitutes a modification of the conveyor 2 shown in Fig. 1. All such parts of the conveyor 2a which are identical with or plainly analogous to those of the conveyor 2 are denoted by similar reference characters each followed by the letter "a".

The cheeks 8a, 10a on the holder 6a in the conveyor 2a flank a suction chamber 48a and respectively carry rows of ceramic or partly ceramic sections 16a, 18a replacing the one-piece walls or inserts 16, 18 shown in Figs. 1 and 2. The sections 16a, 18a respectively

include substantially trapeziform extensions or  
projections 51, 52 which overlie relatively small por-  
tions of the upper side of the lower reach 20 of the end-  
less belt (not shown in Fig. 3) to prop the lower reach  
of this conveyor from above but to still permit the  
suction chamber 48a to draw tobacco particles into the  
path 1a and against the underside of the continuously  
advancing lower reach of the endless belt. The  
projections 51 alternate with the projections 52, as seen  
in the longitudinal direction of the path 1a, and at  
least some of their exposed surfaces have configurations  
corresponding to those on the exposed surface of the rind  
of an orange, lemon or an analogous fruit. This is  
indicated in Fig. by the dots 50 on the projections 51,  
52 and on the major parts of the inserts or walls 16a,  
18a. Such configuration of surfaces contacting the  
running endless belt and the advancing stream of tobacco  
particles in the path 1a greatly reduces the likelihood  
of extensive and/or rapid wear upon the surfaces of the  
walls 16a, 18a and their respective projections 51, 52  
(if any).

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of the above outlined contribution to the art of apparatus for advancing streams of particulate smokable material and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the appended claims.